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Practice-based methodology for effectively modeling and documenting search, protection and innovation

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Abstract

This work relates to a methodology for effectively modeling an Action and Problem System and documenting a path built by means of patent databases. The aim of this work is to provide an improved method and operative tool for a quick and reliable patents investigation driven by Boolean algorithms.
The method has been tested with several projects for companies of different industrial areas. Moreover in the last months the method has been used in case studies by students from the University of Bergamo with good results after a very few hours of training.
Two specific case studies will be discussed in this paper in order to clarify the operative value of said method and to show the results obtained in terms of solutions found and of efforts requested.

Keywords: Kinetic model; Potential model; Patent investigation; Patent databases;

1. Introduction

In the last years Intellectual Property (IP) issues has been getting increasing attention form companies and research centres. This is mainly due to two factors: (1) the need of companies for a better protection of the results of R&D activities and (2) the emerging awareness of the unexploited value of their patents, e.g. for non-competitive applications in other industrial sectors.

As IP is becoming more and more a key asset also for SMEs, the research on methods and tools to perform patent search, analysis and circumvention represent a crucial matter.

The aim of this work is to provide an improved method and operative tool for a quick and reliable patents investigation driven by Boolean algorithms [1]. The method proposed took its origins by existing methods, such as:

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FOS (Function-Oriented Search) developed by Litvin [2] and APOS (Function an Problem Oriented Search) by Axelrod [3].

2. Proposed method

The proposed method consists in defining:

- the intrinsic and extrinsic factors capable of describing the context that is the object of the quest, protection and innovation;
- the relationship between said intrinsic and extrinsic factors;
- an Action-and-Problem system as a physical expression of its combination with said intrinsic and extrinsic factors and their relationship;
- the results of a constraining action on the model developed.

Three different model are used to carry out this new method for patent investigation: Kinetic model, Potential model and Forced Model. The terms used in the followings are freely inspired to physics and should be intended with a general meaning.

A *Kinetic Model* [M] = $f(V, \rho)$ of a system is an expression of Class[3] V to which said system refers and the intrinsic characteristic ρ of said class V.

A *Potential Model* [K] = $f(A, E)$ of a system is an expression of the Subclass or Group A to which said system refers and the extrinsic properties E of said subclass or group A.

No relationship exists between Kinetic Model [M] and Potential Model [K], if taken separately.

Forced Model is the model obtained combining the class V and its intrinsic characteristic ρ, and the subclass A and its extrinsic properties E, and it is exerted by a force [F] to gather the required set of patents.

The analogy with Lagrange's equations, as expressions of kinetic energy and potential energy and their transformation into the equation of motion $[M]\ddot{x}+[K]x = f$, supports inventors by determining the meaning of intrinsic and extrinsic factors and of their relationships for the presented method. Thus, the parameters of a *Kinetic Model* [M] = $f(V, \rho)$ are analogue to Volume (V) and Density (ρ) of masses of a discrete system while the parameters of a *Potential Model* [K] = $f(A, E)$ meet analogy with Area (A) and Modulus of Elasticity (E) of springs of a discrete system.

3. Methodology application

The method has been tested with several projects for companies of different industrial areas. Moreover in the last months the method has been used in case studies by students from the University of Bergamo with good results after a very few hours of training.

Two specific case studies are discussed in the followings in order to clarify the operative value of said method and to show the results obtained in terms of solutions found and of efforts requested. In order to show the wide range of application of the method the chosen cases belong to different industrial field (ICT and mechanical) and provide a solution to different goals.

The former case relates to the analysis of a European patent application that does not meet the requirements of the European Patent Convention (EPC); an investigation of the state of the art has been enterprised in order to answer to a Communication pursuant to article 96(2) of EPC.

The latter relates to the field of Pressure Die Casting or Injection Die Casting: thermal expansion and corrosion of an automotive piece generate problems, which are analysed within the process comprising firstly die casting, and secondly galvanisation.

3.1. Study case 1: Communication pursuant to article 96(2) of EPC

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[3]Classes, Subclasses and Groups are taken from IPC (International Patent Classification) www.wipo.int/classifications/ipc/en/

This case refers to a real issue some inventors had to face to convince the European Auditors of the innovative value of their software product. The key topic consists in demonstrating that sending an end users based in a specific location ads from companies based in the same area is a clearly an innovative feature of messaging-service. Thanks to the Kinetic and a Potential Model approach the problem system will be modelled and forced, and a certain set of meaningful patents will be quoted.

The documentation about the problem of this case study can be found using the Customer Service of the European Patent Office that includes an “online Public File inspection” http://ofi.epoline.org/view/GetDossier. Actually, this site allows sorting out documents by publication number (in this case EP1363430: - EUROPEAN PATENT APPLICATION NO. 02425294.2) as those reported in the followings.

The first claim reports: [System for managing and transmitting digital information by means of a messaging system [] characterized in that comprises a protocol [] being able to be automatically executed in order to send [] a set of pieces of information comprising advertising messages that can be divided into geographical communication environments, said environments being in particular Nation, Province or Municipality of the user.]

From the Annex to the Communication (March 2006), par. 1: [The statement “a set of pieces of information comprising advertising messages that can be divided into geographical environments” used in claim 1 is vague and unclear and leaves the reader in doubt as how a piece of information is divided into geographical environments … (Article 84 EPC)].

A Kinetic Model [M] of this statement, referring to the object of the patent application, is represented by the following Boolean expression:

[M] = *f(V, ρ) = ((string OR command) <in> AB) AND ((protocol OR draft OR record) <in> TI)* (1)

where:

- *protocol, draft, record* = class *V* of the system object of patent application;
- *string, command* = intrinsic characteristic ρ of said class *V*.

The classes according to IPC-R) characterizing the Boolean algorithm (1) applied to a Patent DB are explained in fig. 1.

Result Set for Query: (((string OR command) <in> AB) AND ((protocol OR draft OR record) <in> TI))

Collections searched: **US (Granted), European (Applications), European (Granted), WIPO PCT Publications, US (Applications)**

4,603 matches found of 9,546,891 patents searched

IPC-R Code- 4 digit	Items	%	Bar Chart
G11B G — Physics ; Information Storage ; Information Storage B	1486	23.3 %	
H04N H — Electricity ; Electric Communication Technique ; Pict	936	14.7 %	
G06F G — Physics ; Computing ; Calculating ; <IPCTEXT< FONT>	870	13.6 %	
H04L H — Electricity ; Electric Communication Technique ; Tran	674	10.6 %	
H04Q H — Electricity ; Electric Communication Technique ; Sele	193	3.0 %	

Fig. 1: main IPC-R classes of [M]

A Potential Model [K] of this statement is represented by the following Boolean expression:

[K] = *f(A, E) = ((discrimin* OR divid* OR separat*) <in> AB) AND ((manag*) <in> AB)* (2)

where:

- *management* = subclass *A* of the object of patent application;
- *discriminating, dividing, separating* = functional action, as extrinsic properties *E* of subclass *A*.

The Classes according to IPC-R characterizing the Boolean algorithm (2) applied to a Patent DB are explained in the table of fig. 2.

Result Set for Query: ((((discrimin* OR divid* OR separat*) <in> AB)) AND ((((manag*) <in> AB))))

Collections searched: **US (Granted), European (Applications), European (Granted), WIPO PCT Publications, US (Applications)**

6,246 matches found of 9,551,220 patents searched

IPC-R Code- 4 digit	Items	%	Bar Chart
G06F G — Physics ; Computing ; Calculating ; <IPCTEXT< FONT>	2173	26.5 %	

H04L H — Electricity ; Electric Communication Technique ; Tran	1085	13.2 %	
H04N H — Electricity ; Electric Communication Technique ; Pict	567	6.9 %	
G11B G — Physics ; Information Storage ; Information Storage B	525	6.3 %	
H04Q H — Electricity ; Electric Communication Technique ; Sele	483	5.8 %	

Fig. 2: main IPC-R classes of [K]

[M] and [K] respect the following condition:

Main IPC-R classes of [M]	$\neq$	*Main IPC-R classes of [K]*	(3)
G11B INFORMATION STORAGE		G06F ELECTRIC DIGITAL PROCESSING	
H04N PICTORIAL COMMUNICATION, e.g. TELEVISION		H04L TRANSMISSION OF DIGITAL INFORMATION	

The sentence (3) allows to combine [M] and [K] constituting a Model of the class *V* and its intrinsic characteristic *ρ*, and the subclass *A* and its extrinsic properties *E*.

An example of a bad Model, due to the coincidence of main classes IPC-R of [M3] and [K3]:

[K3] = ((discrimin OR divid* OR separat*) <in> AB) AND ((protocol OR draft OR record) <in> TI);*

[M3] = ((geograph) <in> AB) AND ((environment) <in> TI);*

is represented by tabs of fig. 3.

Result Set for Query: K3 = ((((discrimin* OR divid* OR separat*) <in> TI)) AND ((((protocol OR draft OR record) <in> AB))))

Collections searched: **US (Granted), European (Applications), European (Granted), WIPO PCT Publications, US (Applications)**

1,023 matches found of 9,525,564 patents searched

IPC-R Code- 4 digit	Items	%	Bar Chart
H04L H — Electricity ; Electric Communication Technique ; Tran	70	60.9 %	
H04B H — Electricity ; Electric Communication Technique ; Tran	10	8.7 %	
H04M H — Electricity ; Electric Communication Technique ; Tele	10	8.7 %	

Result Set for Query: M3 = (((geograph*) <in> AB) AND ((environment) <in> AB))

IPC-R Code- 4 digit	Items	%	Bar Chart
H04L H — Electricity ; Electric Communication Technique ; Tran	73	12.3 %	
G06F G — Physics ; Computing ; Calculating ; <IPCTEXT< FONT>	71	11.9 %	
G06Q G — Physics ; Computing ; Calculating ; <IPCTEXT< FONT>	68	11.4 %	

Fig. 3: main classes IPC-R [M3] = main classes IPC-R [K3]

The main IPC-R group obtained by the Boolean algorithm (2) is H04L12/56 (TRANSMISSION OF DIGITAL INFORMATION, PACKET SWITCHING SYSTEMS). The tab of fig. 4 represents the IPC-R Code of classes constituting the main group H04L12/56.

Result Set for Query: K = ((((discrimin* OR divid* OR separat*) <in> AB)) AND ((((manag*) <in> AB))))

Work File: K-->H04L12/56

IPC-R Code- 4 digit	Items	%	Bar Chart
H04L H — Electricity ; Electric Communication Technique ; Tran	394	64.2 %	
H04Q H — Electricity ; Electric Communication Technique ; Sele	137	22.3 %	
G06F G — Physics ; Computing ; Calculating ; <IPCTEXT< FONT>	34	5.5 %	
H04J H — Electricity ; Electric Communication Technique ; Mult	18	2.9 %	
H04B H — Electricity ; Electric Communication Technique ; Tran	14	2.2 %	
H04M H — Electricity ; Electric Communication Technique ; Tele	12	1.9 %	

H04H H — Electricity ; Electric Communication Technique ; Broa	2	0.3 %	
H04N H — Electricity ; Electric Communication Technique ; Pict	2	0.3 %	
(Below cutoff)	1	0.163	

Fig. 4: IPC-R Class Code of main group H04L12/56

The combination of every class forming the main group H04L12/56 with the Boolean algorithm (1) allows the individuation of two relevant IPC-R classes (fig. 5). The relative global Model is represented by the Boolean algorithms:

[K(G06F)] AND [M] = ((G06F) <in> IC) AND
((string OR command) <in> AB) AND ((protocol OR draft OR record) <in> TI)) (4a)
[K(H04N)] AND [M] = ((H04N) <in> IC) AND
((string OR command) <in> AB) AND ((protocol OR draft OR record) <in> TI)) (4b)

The Model represented by algorithms (4a) and (4b) can be forced. In the specific case, the geographic management of a software, discussed on the Comunication pursuant Article 96(2) IPC, is a force applied to algorithm (4a):

[F] = ((geograph OR regional) <in> AB)* (5)

The exerted Model is:

[K(G06F)] AND [M] AND [F] = ((G06F) <in> IC) AND ((string OR command)<in> AB)
AND ((protocol OR draft OR record) <in> TI)) AND ((geograph OR regional) <in> AB))* (6)

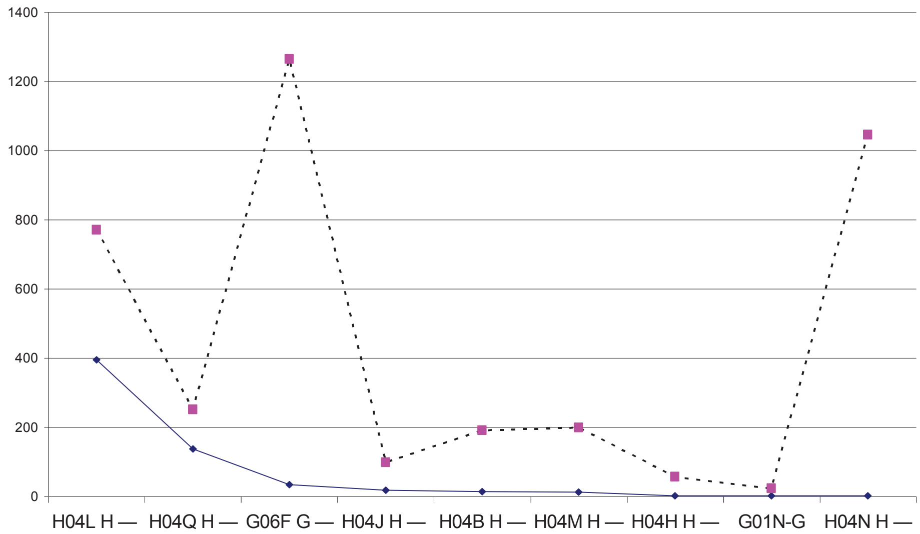

Fig. 5: [K(IPC-R Class H04L12/56)] + [M]

Results of exerted model:

WO03077116A2 **SYSTEM MANAGEMENT CONTROLLER NEGOTIATION PROTOCOL**
A computer system module includes a system management controller to negotiate with other system management controllers to determine the controller's initial operational state. In an embodiment, negotiation with other system management controllers is based at least in part on one of controller capability, user configured preference, module type, and geographical address.

WO03021461A1 **SYSTEM AND METHOD FOR INTEGRATING VOICE OVER INTERNET PROTOCOL NETWORK WITH PERSONAL COMPUTING DEVICES**
A method and system state-of-the-art integration of a personal computing device with a

private VOIP network and the PSTN (202) to control voice sessions on telephony devices (102, 106) of residential and business PC users across a geographic region shown.

3.2. Case study 2: Corrosion plus thermal expansion of an automotive piece

The problem of thermal expansion and corrosion of an automotive piece involves two phases of the process: die casting and galvanisation. Thus, two Kinetic Models are defined while only one Potential Model is needed to represent the extrinsic features of both phases, because they refer to the same global process.

The Kinetic Model [M*dc*] of die casting is expressed by:

$$[\mathrm{Mdc}] = f(V_{dc}, \rho_{dc}) = ((\mathit{metal}^{*})\ \langle in \rangle\ AB)\ \mathit{AND}\ ((\mathit{fluid}^{*})\ \langle in \rangle\ TI) \qquad (7)$$

where:

metal = object of die casting, corresponding to the class V of die casting;

fluid = a characteristic of die casting (e.g. spry, powder, etc.), corresponding to the intrinsic factor ρ of said class V. Classes according to IPC-R characterizing the Boolean algorithm (7) applied to a Patent DB are explained in fig. 6.

Result Set for Query: Mdc = ((((((metal*) <in> AB) AND ((fluid*) <in> TI)))))

Collections searched: **US (Granted), European (Applications), European (Granted), WIPO PCT Publications, US (Applications)**

- **4,430** matches found of 9,555,221 patents searched

IPC-R Code- 4 digit	Items	%	Bar Chart
C10M C — Chemistry ; Metallurgy ; Petroleum, Gas or Coke Indus	539	7.5 %	
B01J B — Performing Operations ; Transporting ; Physical or CH	418	5.8 %	
C09K C — Chemistry ; Metallurgy ; Dyes ; Pai	379	5.3 %	
F16L F — Mechanical Engineering ; Lighting ; Heating	337	4.7 %	
B01D B — Performing Operations ; Transporting ; Physical or CH	263	3.6 %	

Fig. 6: main IPC-R classes of [Mdc]

While the Kinetic Model [M*g*] of galvanisation is:

$$[\mathrm{Mg}] = f(V_{g}, \rho_{g}) = ((\mathit{metal}^{*})\ \langle in \rangle\ TI)\ \mathit{AND}\ ((\mathit{coat}^{*})\ \langle in \rangle\ TI) \qquad (8)$$

where:

metal = object of galvanisation, corresponding to the class V of galvanisation;

coat = a characteristic of galvanisation, corresponding to the intrinsic factor ρ of said class V.

Classes according to International Patent Classification (IPC-R) characterizing the Boolean algorithm (8) applied to a Patent DB are explained in fig. 7.

Result Set for Query: Mg = ((((((metal*) <in> TI) AND ((coat*) <in> TI)))))

Collections searched: **US (Granted), European (Applications), European (Granted), WIPO PCT Publications, US (Applications)**

- **7,757** matches found of 9,555,221 patents searched

IPC-R Code- 4 digit	Items	%	Bar Chart
C23C C — Chemistry ; Metallurgy ; Coating Metallic Material</I<	2672	20.1 %	
C09D C — Chemistry ; Metallurgy ; Dyes ; Pai	1330	10.0 %	
B05D B — Performing Operations ; Transporting ; Spraying or AT	993	7.4 %	
C25D C — Chemistry ; Metallurgy ; Electrolytic or Electrophore	544	4.0 %	
H05K H — Electricity ; Electric Techniques Not Otherwise Provided For ;	363	2.7 %	

Fig. 7: main IPC-R classes of [Mg]

A common Potential Model [K] can be used for both casting and galvanisation phases.Its Boolean representation is:

[K] = *f(A, E)* = *((35,Parameter Change) <in> AB) AND ((zinc OR Copper) <in> AB))* (9)

where:

- *zinc, copper* = subclass of metal, corresponding to subclass or group *A* of the process;
- *Parameter Change* = action of the process, corresponding to the extrinsic properties *E* of said subclass or group *A*.

Classes according to International Patent Classification (IPC-R) characterizing the Boolean algorithm (9) applied to a Patent DB are listed in fig. 8.

Result Set for Query: **K** = (((35 Parameter Change)) <in> AB) AND ((zinc OR Copper) <in> AB))

Collections searched: **US (Granted), European (Applications), European (Granted), WIPO PCT Publications, US (Applications)**

- **4,434** matches found of 9,555,221 patents searched

IPC-R Code- 4 digit	Items	%	Bar Chart
H01L H — Electricity ; Basic Electric Elements ; Semiconductor	434	6.0 %	
B01J B — Performing Operations ; Transporting ; Physical or CH	357	4.9 %	
C23C C — Chemistry ; Metallurgy ; Coating Metallic Material</I< FONT>	323	4.5 %	
H05K H — Electricity ; Electric Techniques Not Otherwise Provided For ;	237	3.3 %	
C07C C — Chemistry ; Metallurgy ; Organic Chemistry	216	3.0 %	

Fig. 8: main IPC-R classes of [K]

[Mdc] and [K] respect the following condition:

Main IPC-R classes of [Mdc]	≠	*Main IPC-R classes of [K]*	(10)
C10M LUBRICATING COMPOSITIONS		H01L SEMICONDUCTOR DEVICES	
~~B01J CHEMICAL OR PHYSICAL PROCESSES, e.g. CATALYSIS, COLLOID CHEMISTRY~~		~~B01J CHEMICAL OR PHYSICAL PROCESSES, e.g. CATALYSIS, COLLOID CHEMISTRY~~	

The sentence (10) allows to combine [Mdc] and [K] to constitute a Model representative of the die casting. However, this model has same limits due to the coincidence of a main class. [Mg] and [K] respect the following condition:

Main IPC-R classes of [Mg]	≠	*Main IPC-R classes of [K]*	(11)
C23C COATING METALLIC MATERIAL		H01L SEMICONDUCTOR DEVICES	
C09D COATING COMPOSITIONS,		B01J CHEMICAL OR PHYSICAL PROCESSES, e.g. CATALYSIS, COLLOID CHEMISTRY	

The sentence (11) allows to combine [Mg] and [K] to constitute a Model representative of the galvanisation. The main IPC-R group obtained by the Boolean algorithm (9) is H01L21/02 (Manufacture or treatment of semiconductor devices). The tab of fig. 9 represents the IPC-R Code of classes constituting the main group H01L21/02.

IPC-R Code- 4 digit	Items	%
H01L H — Electricity; Basic Electric Elements; Semiconductor	206	54.8 %
C25D C — Chemistry; Metallurgy; Electrolytic or Electrophore	38	10.1 %
C23C C — Chemistry; Metallurgy; Coating Metallic Material</I<	29	7.7 %
H05K H — Electricity; Electric Techniques Not Otherwise Provided For;	21	5.5 %
B24B B — Performing Operations; Transporting; Grinding</IPCT<	13	3.4 %
C30B C — Chemistry; Metallurgy; Crystal Growth (se	10	2.6 %
C23F C — Chemistry; Metallurgy; Coating Metallic Material</I< FONT>	8	2.1 %
C09G C — Chemistry; Metallurgy; Dyes; Pai	7	1.8 %
C25F C — Chemistry; Metallurgy; Electrolytic or Electrophore	7	1.8 %
B08B B — Performing Operations; Transporting; Cleaning</IPCT<	5	1.3 %

B23K B — Performing Operations; Transporting; Machine Tools<	5	1.3 %
C08G C — Chemistry; Metallurgy; Organic Macromolecular Compo	3	0.8 %
G03F G — Physics; Photography; Cinematography; <IP< FONT>	3	0.8 %
C08L C — Chemistry; Metallurgy; Organic Macromolecular Compo	2	0.5 %
H01J H — Electricity; Basic Electric Elements; Electric Disc	2	0.5 %

Fig. 9: IPC-R Class Code of main group H01L21/02

The combination of every class constituting the main group H01L21/02, respectively with the Boolean algorithms (7) and (8) allows to individuate relevant classes and relative global Models:

[K(B01J)] AND [Mdc] = ((B01J) <in> IC) AND ((metal) <in> AB) AND ((fluid*) <in> TI))* (12)

[K(C09D)] AND [Mg] = ((C09D) <in> IC) AND ((metal) <in> TI) AND ((coat*) <in> TI))* (13)

The global Model of the process (die casting + galvanisation) represented by algorithms (12) and (13) can be forced in a way to solve thermal expansion and corrosion problems. The exerted Model with a force:

[F] = ((galvanis) <in> AB))* (14)

is:

[K(C09D)] AND [Mg] AND [F] = ((metal) <in> TI) AND ((coat*) <in> TI) AND ((c09d) <in> IC)) AND ((galvanis*) <in> AB))* (15)

Results of exerted model (15):

WO03076534A1 **SURFACE BASE-COAT FORMULATION FOR METAL ALLOYS** Chromium-free coating composition with anti-corrosion and anti-fingerprint properties, particularly suitable for metal alloys, especially galvanized steel, and coated articles. Composition comprises aqueous-resin emulsion, hazardous air pollutant-free co-solvent, organo-functional silane, metal chelating agent, and chromium-free corrosion inhibitor, and optionally pH adjusting agent.

WO9920696A1 **METHOD FOR COATING METALS AND METAL COATED USING SAID METHOD** The invention relates to a method for coating surfaces consisting of steel, tinned steel, galvanised steel, zinc-alloy-coated steel or aluminium. A solution or a dispersion of a source of ions of bivalent to tetravalent metals and an organic film former and a solution or a dispersion ofa source of phosphate ions and an organic film former are applied to the metal surface in any order, together or one after the other, and dried in, giving a total dry layer thickness of 0.2 to 3 g/m2. The invention also relates to metal parts coated using the inventive method.

4. Conclusion

A structured model of the language applied in a patent-database according to the guidelines as described in this paper allows the development of new research, protection and innovation –strategies by investigating those technological fields which share the same intrinsic parameters. This methods allows to find patent technological classes according to IPC-R, overcoming the pure meaning of the words.

Although the method is still subjected to refinements, it has already been successfully applied to a number of cases showing the high potentiality of the former ideas. The way of performing patent investigation presented in the paper has also been tested by last-year students of the Faculty of Engineering of the University of Bergamo, demonstrating good consistency, ease of use and efficiency of the method.

Thanks to the reliability of the results and to the possibility of certifying the approach applied, this method has been accredited to check investment-plans developed by main Preliminary Investigation Bodies for Enterprise Investors.

Future activities will aim at providing a wider set of case studies and expertise on the pros and cons of the approach developed so far in order to continuously improve it. Further, the opportunity to develop a tool to enhance automation in the definition of parameters and classes will be studied.

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